

## Paper Engineering: Bringing paper to life, from 2-Dimensional to 3-Dimensional.

### Overview:

This outreach scheme of work introduces paper engineering and the process of iterative design. These lessons aim to give children the basic knowledge of paper engineering, creating foundation pop-ups and mechanisms to create their own pop-up book.

There are 6 to 8 lessons, with each one taking 1-2 hours each. (Aimed for a half term of lessons, if teaching an hour a week, you will likely need the full 8 weeks, if teaching 2 hours a week, you should be able to complete in 6 weeks).

**Learning objective:** To create a 3D pop-up book suitable for a small child.

### Success criteria:

- (SC1) I can explain advantages and disadvantages of pop-up books
- (SC2) I can identify advantages and disadvantages of making 3D shapes from flat sheets.
- (SC3) I can describe how folding a flat (2D) sheet of paper makes it a 3D object.
- (SC4) I can describe how different cuts and folds can make different 3D shapes.
- (SC5) I can make a pop-up designs following instructions.
- (SC6) I can make a pop-up designs from a blank piece of paper.
- (SC7) I can identify the difference between pop-ups and mechanisms
- (SC8) I can create a short, fun story and make it into a pop-up book.

### Resources you will need to provide

Rulers  
Pencils  
Scissors  
Coloured pens/pencils (*e.g.* felt tips/crayons)  
Existing pop-up books, or use videos in resources section

### Optional extra items:

Thick card  
Decorative resources (*e.g.* tissue paper, small pompoms, sequins, glue for attaching decorations)

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### Overview:

This scheme of work will ideally be taught over a 6 to 8 week half term, each lesson should run for approximately 100 minutes (90 minute to 140-minute lessons)

It will be tight to complete successfully, taught for 6 weeks and 90-minute lessons.

\*If you are teaching the project over 6 weeks, use lessons: 1, 2, 3, 4, 5 and 7 – lessons 6 and 8 are extra lessons for making pop-ups/mechanisms, decorating, assembly and making a cover.

Lesson	Input/activity	Resources
Lesson 1	<p><b>Introduction:</b> If you have some pop-up books share these with the children, get them to think about: how fragile they are? What is their favourite page and why? Can they tell the difference between a pop-up and a mechanism? Can they work out how the pop ups work? A pop-up does just that, pops up when the page is opened, a mechanism, could be a flap, something that rotates or slides backwards and forwards.</p> <p><b>Main:</b> Show the children some examples of V-fold and Box pop ups, can they find any examples of these in the books that they have looked at, or in the videos. Have a go at making the V-fold pop up, following the instructions given <b>(video)</b> (SC5) Have a go at making the Box Fold pop up, following the instructions given <b>(video)</b> (SC5) Depending on your group, you might be best to show them as you create one, you can discuss the limitations of each type of pop-up (SC2)</p> <p><b>Assessment:</b> Children should be able to articulate the advantages and disadvantages of pop-up books (SC1) You could get the pupils to write instructions of how to complete the pop-ups, or use sheets provided and they can annotate them (SC3 &amp; SC4)</p>	<p><a href="#">PowerPoint for lesson 1</a></p> <p>Videos of existing pop-up books: <a href="#">Dinosaur</a> <a href="#">Haunted House</a></p> <p><a href="#">V-Fold Video</a></p> <p><a href="#">Box Fold Video</a></p> <p><a href="#">V-Fold Template</a></p> <p><a href="#">Box Fold Template</a></p> <p>Assessment Sheets: <a href="#">V-fold</a> <a href="#">Box fold</a></p>
Lesson 2	<p><b>Introduction:</b> Looking at the essential techniques for accurate pop up making, folding, scoring (breaks the fibres to give clean folds), creasing, measuring, and cutting. <b>(video)</b></p> <p><b>Main:</b> Last lesson you would have had a go at making the V-fold pop up and the Box pop up, if you didn't get to make one then have a go at these first (see lesson 1 for resources) Have a go at making the variations of V-Fold pop-up , following the instructions <b>(video)</b> (SC5) Have a go at making the variations of Box Fold pop, following the instructions <b>(video)</b> (SC5) Make a few prototypes and encourage the pupils to change the size and position of the V-fold and the picture. Discussions could be around any problems that they encounter. (SC5 &amp; SC6) Do the same with the box fold, discussing challenges during the lesson. This could be done with a show and tell mini plenary. Extension – Those more able, could combine the v-fold and box fold in one card, see what they come up with.</p> <p><b>Assessment:</b> Children should be able to demonstrate and explain the importance of folding and scoring to make a smooth and flexible fold. Show how they have been able to create a strong pop-up movement. Questions to ask: Do any of the pop ups stick out from the cards when they are closed? Is there anything that needs to be improved and what would you need to do to improve it? (SC3 &amp; SC4)</p>	<p><a href="#">PowerPoint for lesson 2</a></p> <p><a href="#">Video for essential techniques</a></p> <p>Videos of variation of V-Fold: <a href="#">Mouth</a> <a href="#">Angle</a></p> <p>Videos of variations of Box Fold: <a href="#">Double Box</a> <a href="#">Tent</a></p> <p>Assessment Sheets: <a href="#">Essential</a> <a href="#">Techniques</a></p>
Lesson 3	<p><b>Introduction:</b> Recall the importance of different techniques: folding, scoring (breaks the fibres to give clean folds), creasing, measuring, and cutting. Discuss what each one does. And the folds done so far and what you could create with them. (SC3 &amp; SC4)</p> <p><b>Main:</b> Recall the variations of V-Fold and Box Fold Pop-ups. Last lesson you would have had a go at making variations of the V-fold pop up and the Box pop up, if you didn't get to some, then have a go at these first (see lesson 2 for resources) Now we have looked at Pop-ups. We will look at some 'Mechanisms' Sliding Mechanism and Rotary Mechanism. Discussions could be around any problems that they encounter and how they could use these techniques. (SC5 &amp; SC6) <b>(video)</b></p> <p><b>Assessment:</b> Successfully made and explained more pop-ups and some mechanisms. Can confidently explain the difference between pop-up and mechanisms. (SC7) Pupils should be able to write instructions of how to complete the sliding and/or rotary mechanisms, or use sheets provided and they can annotate them. (SC3 &amp; SC4)</p>	<p><a href="#">PowerPoint for lesson 3</a></p> <p>Videos for: <a href="#">Sliding Mechanism</a> <a href="#">Rotary Mechanism</a> <a href="#">Lift-up Flaps</a></p> <p>See lesson 2 for videos for: Mouth Fold Angle Double Box Fold Tent</p> <p>Assessment Sheets: <a href="#">Slider mechanism</a></p>

		<a href="#">Rotary mechanism</a>
Lesson 4	<p><b>Introduction:</b> Story planning, who is your audience for your book? Is it a story or fiction? What are the user's needs? Think about colour, text type and placement. Is there a theme? Is it educational? Think about what different pop-ups and mechanisms seen so far can be used in an exciting way in a book. (SC8)</p> <p><b>Main:</b> Story Board – Plan your story, what pop-ups / mechanisms will you use, where will they be placed, think about how they pop out, are they better portrait or landscape? Your book needs to be one or the other! (SC8)</p> <p><b>Assessment:</b> Can they explain their story and what pop-ups will be used, are they the best choice for what they want? Small group discussions to help each other improve their ideas. (SC1)</p>	<p><a href="#">PowerPoint for lesson 4</a></p> <p><a href="#">Story Board Planning</a></p> <p>Story Board Templates: <a href="#">Landscape</a> <a href="#">Portrait</a></p>
Lesson 5	<p><b>Introduction:</b> Think-Pair-Share – Get pupils to think about their story plan, in pairs talk to each other and share opinions of WWW (what works well) and EBI (Even better if)</p> <p><b>Main:</b> Using the storyboards, start making the pages for their books, create the pop up / mechanism first, get all the pages completed with any pop-ups and mechanisms, then add decoration, extra parts etc. Don't forget everything that you have learnt so far, do you need to make any changes, based on your think-pair-share activity? If yes, now is the time to do this, don't rush, be accurate. (Don't try to assemble, that's next week! – Lesson 7) (SC5, SC6 &amp; SC8)</p> <p>Pages of the PowerPoint show the making of the Warwick Racing Pop-up Book.</p> <p><b>Assessment:</b> How's it going? Quick check around the classroom, to see how everyone is doing, have they completed most of their pages? This will help plan for the last lesson. NB. If anyone is behind, they could finish decorating for homework.</p>	<a href="#">PowerPoint for lesson 5</a>
Lesson 6 (extra lesson*)	<p><b>Introduction:</b> A continuation of lesson 5, discuss what needs to be done: complete pop-ups and/or mechanisms, add colour to all pages. Use your storyboard to help you know what needs to be done.</p> <p><b>Main:</b> Using the storyboards, continue to make the pages for their books, create the pop up / mechanism first, get all the pages completed with any pop-ups and mechanisms, then add decoration, extra parts etc. Don't forget everything that you have learnt so far, do you need to make any changes, based on your think-pair-share activity? If yes, now is the time to do this, don't rush, be accurate. (Don't try to assemble, that's next week! – Lesson 7) (SC5, SC6 &amp; SC8)</p> <p>Pages of the PowerPoint show the making of the Warwick Submarine Pop-up Book.</p> <p><b>Assessment:</b> How's it going? Quick check around the classroom, to see how everyone is doing, have they completed most of their pages? This will help plan for the last lesson. NB. If anyone is behind, they could finish decorating for homework.</p>	<a href="#">PowerPoint for lesson 6</a>
Lesson 7	<p><b>Introduction:</b> What do you need to do today? Are you on track to finish? What makes for an exciting front cover, what other information need to be on the cover?</p> <p><b>Main:</b> Show how they will construct their book: Finish any pages that need finishing, and then start to construct the pages together, make the cover and decorate and attach to the pages to complete the book. (SC5, SC6 &amp; SC8)</p> <p><b>Assessment:</b> Do the pop-ups reflect the intent of the story? Is there a surprise? Which pop-ups are your favourite, how else could you use pop-ups? Complete the Evaluation.</p>	<p><a href="#">PowerPoint for lesson 7</a></p> <p><a href="#">Evaluation Form</a></p>

<p>Lesson 8 (extra lesson*)</p>	<p><b>Introduction:</b> What do you need to do today? Are you on track to finish? What makes for an exciting front cover, what other information need to be on the cover?</p> <p><b>Main:</b> Show how they will construct their book: Finish any pages that need finishing, and then start to construct the pages together, make the cover and decorate and attach to the pages to complete the book. (SC5, SC6 &amp; SC8)</p> <p><b>Assessment:</b> Do the pop-ups reflect the intent of the story? Is there a surprise? Which pop-ups are your favourite, how else could you use pop-ups? Complete the Evaluation.</p>	<p><a href="#">PowerPoint for lesson 8</a></p> <p><a href="#">Evaluation Form</a></p>
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